EARLY AND LONG TERM PREDICTIVE VALUE OF CARDIAC MARKER TROPONIN T AND CK-MB IN ACUTE MYOCARDIAL INFARCTION

Shazia Rashid, Tariq Feroz Khawaja*, Rukhshan Khurshid**

Department of Biochemistry, CMH Lahore Medical College, **Fatima Jinnah Medical College, *Postgraduate Medical Institute, Lahore

Background: Cardiac markers in serum are measured in the early hours after the onset of symptoms not to detect Acute Myocardial Infarction (AMI) but to exclude MI. To rule out AMI, one frequently must rely on the measurement of cardiac enzymes or biochemical markers when patients suspected of AMI present with atypical chest pain or a non-diagnostic ECG. We studied the levels of troponin T, and CK-MB in ruling out AMI in a group of patients in the first 24 hours after the onset of chest pain in the emergency room. **Methods:** Twenty male and 10 female patients in the first 24 hours after the onset of chest pain in the emergency room were included in the study. Patients with chest pain suggestive of myocardial ischemia within 12 hours after the onset of symptoms were eligible for the study, and all gave informed consent before inclusion. 5 males and 5 females with ruling out AMI were considered as controls. Levels of cardiatroponin T (cTnT) and CK-MB were estimated by standard kits. **Results and Conclusion:** Troponin T had a high sensitivity for MI when used as part of a rapid rule-in protocol; however, the use of TnT alone failed to identify the majority of patients and there is a need of CK-MB who had either significant disease or complications. We suggest that in diagnosis of patients with chest pain, both CK-MB and cTnT measurements should be performed on admission to the hospital with duration of chest pain 2–10 hours.

Keywords: Myocardial infarction, CK-MB, cardiac troponin T

INTRODUCTION

Cardiac markers in serum are measured in the early hours after the onset of symptoms not to detect (Acute Myocardial Infarction) AMI but rather to exclude (Myocardial Infarction) MI. According to World Health Organization criteria, the diagnosis of AMI is established when there is typical chest pain suggestive of myocardial ischemia, ST-segment changes or the development of new Q waves on the ECG, and abnormal cardiac enzymes detectable in the peripheral blood. To rule out AMI, one frequently must rely on the measurement of cardiac enzymes or biochemical markers when patients suspected of AMI present with atypical chest pain or a non-diagnostic ECG.[1]

The diagnosis of AMI can be established on the basis of these assays as early as 1.5 to 3 hours after the onset of symptoms. Several biochemical markers for the early detection of myocardial damage have been proposed, of which cardiac troponin T(cTnT), myoglobin and creatine kinase-MB (CK-MB) are the most promising candidates. Serum levels of these markers change rapidly in the early hours after the onset of AMI, therefore, sensitivity and specificity of any particular marker change rapidly over time. Infarct size may influence early sensitivity and specificity of the cardiac marker under study.[2]

TnT is a cardiac-specific protein released during cell injury such as that following acute myocardial infarction (MI). Unlike creatine kinase-MB isoenzymes, TnT is increased in a subset of patients with unstable angina, and these may be at higher risk for subsequent cardiac events.[3] Cardiac troponins have emerged over recent years as the "gold standard" serum biochemical marker for the diagnosis and management for patients with acute myocardial infarction (MI). The relationship between old (creatine kinase; CK) and new (troponin T; TT) markers of myocardial injury was observed in all types of MI.[4]

The enzyme activities of creatine kinase (CK), its isoenzyme MB (CK-MB) have been used for years in diagnosing patients with chest pain in order to differentiate patients with acute myocardial infarction (AMI) from non-AMI patients.[5] Measurements of myoglobin and creatine kinase (CK)-MB isoforms have been suggested to be sensitive tests for the early diagnosis of myocardial infarction (MI).[6] Early diagnosis (within 1.5 hours) was provided by both CK-MB isoforms and CK-MB mass, and then by myoglobin and troponins, in order of decreasing frequency. Creatine kinase-MB mass, myoglobin, and troponin I were selected as the cardiac injury markers.[2] However, it is reported that CK-MB is expressed in human skeletal muscle, and is not 100% specific for the heart. cTnI has been shown to be 100% specific for the heart. While cTnT isoforms are expressed in injured skeletal muscle.[7]

In this study we tried to find out the levels of troponin T, and CK-MB in ruling out AMI in a group of patients in the first 24 hours after the onset of chest pain in the emergency room.

MATERIAL AND METHODS

Twenty male and 10 female patients in the first 24 hours after the onset of chest pain in the emergency room were included in the study. Patients with chest pain suggestive of myocardial ischemia within 12 hours after

the onset of symptoms were eligible for the study, and all gave informed consent before inclusion. Exclusion criteria were severe skeletal muscle damage or trauma, cardiac resuscitation, and inability or refusal to give informed consent. 5 males and 5 females with ruling out AMI were considered as controls. Levels of troponin T were CK-MB were estimated by standard kits.

Student's *t*-test was used to compare the findings of males/females and their controls using SPSS version 15.0. Value of $p<0.05$ was considered statistically significant.

RESULTS

Demographic and biochemical findings in male patients and their controls are tabulated as Table-1. There were no significant differences in age and BMI of male patients and their controls. Family history and history of hypertension were more common in patients compared to controls. All patients had smoking habits. History of chest pain ranged 1–10 hours (Mean=7.93 hours) in patients. In their controls history of chest pain ranged 12–96 hours (Mean=50.42 hrs). This showed a highly significant difference ($p<0.001$). A wide variation in the level of cardiac troponin T was observed. We divided the value of cardiac Tnt in 2 ranges, i.e., 141–366 (Mean=216.30) and 1349–5100 ρg/dl in patients with AMI. These values were significantly increased ($p<0.001$) in patients as compared to their controls. Level of CK-MB was also increased significantly ($p<0.001$) in patients compared to their controls.

Table-1: Demographic and biochemical findings in male patients and their controls

Parameters	Male patients (n=20)	Male Controls (n=5)
Age (yrs)	50.80±8.85	55.80±6.26
BMI	24.50±8.67	22.80±1.92
Life style A/S	10/10	2/3
Family history	8	¼
H/O hypertension	10	3/2
H/O chest pain	7.93±3.81*	50.42±34.36
Smoking	All smokers	Non smokers
Cardiac troponinT (ρg/ml)	216.30±68.30* (141–366) 2849.50±1545.62* (1349–5100)	13.90±3.30
CK-MB (U/l)	116.10±103.18*	6.00±1.58

*$p<0.001$

Demographic and biochemical findings in female patients and their controls are tabulated (Table-2). There was no significant difference in age and BMI of female patients and their controls. Family history and history of hypertension were more common in patients as compared to controls. History of chest pain ranged from 2.5 to 12 hours (mean=5.55 hrs) in patients. In their controls history of chest pain ranged from 6 to 72 hours (Mean=50.01 hrs). This showed a highly significant difference ($p<0.001$). A wide variation in the level of cardiac troponin T was observed. Level of cardiac troponin T and CK-MB were increased significantly ($p<0.001$) in patients as compared to their controls.

Table-2: Demographic and biochemical findings in female patients and their controls

Subjects	Female patients (10)	Female Controls (5)
Age (yrs)	59.40±7.38	58.40±4.51
BMI	22.50±3.69	22.40±2.61
Life style A/S	6/4	2/3
Family history	7	1
H/O hypertension	7	4
H/O chest pain (hrs)	5.55±3.85*	50.01±33.36
Smoking	Non smokers	Non-smokers
Cardiac tropnin T (Pg/dl)	567.40±495.10*	14.38±2.84
CK-MB (mg/dl)	37.90±18.65*	10.20±4.27

*$p<0.001$

DISCUSSION

We observed that AMI was mostly seen in age range 32–60 years. BMI of all patients were within normal limits. Family history, history of hypertension and smoking habits were the major risk factors in AMI. A study reported that effects of smoking include alteration of lipid metabolism through increase in lipolysis, insulin resistance and tissue lipotoxicity. Even very low doses of exposure increase the risk of cardiovascular disease and metabolic alterations.[8]

A wide variation in the level of cardiac troponin T was observed. Higher values of CK-MB and cardiac troponin T (TnT) from 1 to 10 hours after the onset of symptoms were observed in male patients. Wide variations in the values of cardiac Tnt were observed in male patients with AMI, troponin can increase some 1349–5100 fold from the baseline, at a fairly high rate of change. These values were significantly increased ($p<0.001$) in patients as compared to their controls. There was no relationship between demographic variables like age, family history, hypertension, duration of chest pain and the cardiac markers like troponin T and CK-MB. Levels of both cardiac markers were significantly increased in patients as compared to their controls.

Present study is in agreement with Bakkar AJ *et al*[9] who reported the raised values of the CK-MB and indicate it as a marker of early diagnosis of AMI, but they divided the patients into only 2 groups: admission within 4 hours or between 4 and 12 hours after the onset of chest pain. Our study is also in accord with other studies[10,11] who reported 100% sensitivity of troponin T for the detection of AMI. The duration of chest pain of their studied subjects was 6 hours. Ravkilde J *et al*[11] also found an average level of CK-MB, i.e., 118 U/L, ranging from 12–528 U/L. However, their reported sensitivity for troponin T may have been overestimated by late admission or a predominance of patients with large infarcts. The study observed that there is some baseline release of cardiac troponin due to the heart injury caused by the surgical procedure itself. Another study reported that any additional release of cTnT into the circulation

may be due to a perioperative AMI, or a higher degree of injury that is indicative of future adverse events.[12]

There was a presumption that the release of troponin from the damaged heart occurs to the same extent for men and women. Present study attempted to identify gender-specific cut-off concentrations for cardiac troponin and CK-MB. Study observed that the cut-off concentrations of these cardiac markers were more in males than females. It is observed that in males higher values of CK-MB and cTNT were from 1–10 hrs. In females, higher values of CK-MB and troponin T from 2.5 to 12 hrs were seen after the onset of symptoms. According to a study woman have smaller coronary arteries, more diastolic dysfunction, more vague symptoms and higher morbidity and mortality after revascularisation. This suggested that separate male and female cut-off concentrations be established for cardiac troponin to optimally detect myocardial injury.[13] A contradictory report[14] observed no significant gender differences in the tissue content of troponin T.

Our study is in accordance with the studies who observed that troponins are more sensitive for detecting myocardial damage than the creatine kinase-MB isoenzyme due to its higher myocardial tissue content, and is more specific because the cardiac troponin isoform is not found in any other organs or tissues of the body besides the heart.[15,16] However a study reported that troponin is not just a marker of AMI but for any aetiology that can cause cardiac damage, including heart failure, sepsis, myocarditis and renal failure.[17] Another contradiction was observed by a study reporting that although increases in cTnI and cTnT always indicate myocardial damage, the test is not able to identify the mechanisms responsible for this damage, which may not be due to ischaemia, but due to other clinical conditions.[18]

CONCLUSION

Troponin T had a high sensitivity for MI when used as part of a rapid rule-in protocol; however, the use of TnT alone failed to identify majority of patients who had either significant disease or complications and there is a need of CK-MB estimation in them. In diagnosis of patients with chest pain, both CK-MB and cTnT measurements should be performed on admission to the hospital with duration of chest pain from 2 to 10 hours.

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Address for Correspondence:

Dr. Shazia Rashid, Department of Biochemistry, CMH Lahore Medical College, Lahore. **Cell:** +92-323-3806847
Email: shazia.rashid9@gmail.com